

B3 -It is also an object of the present invention to provide a process for continuous recovery of the ions of interest for example contaminants in liquid streams or value added products from waste streams using a Liquid-Solids Circulating Fluidized Bed (LSCFB) ion exchange system -

Please replace the paragraph beginning on page 2 line 21 with the following 2 paragraphs

B4 ~~Sub E1~~
- Broadly the present invention relates to a fluidized bed system comprising a first fluidized bed, said fluidized bed being a conventional fluidized bed, means to feed solids into said first fluidized bed adjacent to a first end of said first fluidized bed and means to feed a first fluid into said first fluidized bed adjacent to a second end of said first fluidized bed, said second end being remote from said first end so that said solids and said first fluid flow in counter current, a second fluidized bed, said second fluidized bed being an entraining fluidized bed wherein a means for introducing solids and a means for introducing a second fluid into said second bed are both adjacent to the one end of said second fluidized bed so that said solids and said second fluid introduced into said second bed flow concurrently through said second bed from said one end toward another end of said second fluidized bed remote from said one end, first means connecting said first fluidized bed to said second fluidized bed adjacent to said second end of said first fluidized bed and said one end of said second fluidized bed and said first means connecting including said means to feed solids into said second fluidized bed, and second means connecting said first and said second fluidized beds adjacent said first end of said first bed and said other end of said second fluidized bed, and said second means connecting including said means to feed solids into said first fluidized bed.

Preferably said first and said second means connecting being adapted to form a hydraulic seal between said first and second fluidized beds -

Please replace the paragraph beginning on page 3 line 12 with the following

B5 Preferably said first means connecting said first and said second fluidized beds includes a second washer for washing solids adjacent to said second end of said first fluidized bed before they are introduced into said second fluidized bed.

Please replace the paragraph beginning on page 3 line 15 with the following

B6 -Preferably said first fluidized bed is an absorber for separating ionic products of interest and

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cont.

said second fluidized bed is a desorber for desorption of ionic products and said solids are ion exchange particles. That is, the said liquid-solid circulating fluidized bed system can preferably be used to recover ionic products of interest by passing ion exchange particles in countercurrent flow with a feed stream of a first fluid through a first fluidized bed for adsorption of ionic products of interest from said feed stream of said first fluid, transferring said particles with adsorbed ionic products of interest from said first fluidized bed to a second fluidized bed and passing said ion exchange particles with adsorbed ionic products in cocurrent flow with an extract buffer of a second fluid through said second fluidized bed for desorption of said adsorbed ionic products of interest, separating said second fluid containing said ionic products of interest desorbed from said ion exchange particles by said second fluid to provide regenerated ion exchange particles and returning said regenerated ion exchanged particles into said first fluidized bed to flow in countercurrent with said first fluid.-

The paragraph beginning at page 3 line 19 has been deleted

Please replace the paragraph beginning on page 5 line 23 with the following

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-The distributor of the second fluidized bed 12 divides the incoming stream of extracting buffer 28 into two sub-streams: the primary 60 and the auxiliary 62 streams. The primary stream 60 is introduced through nozzle 30 which projects into the second fluidized bed column 12. This design increased the pressure drop across the bottom solids return pipe 42 and makes the system more stable. The auxiliary stream 62 is introduced into the bottom 26 of the second fluidized bed 12 through a perforated plate inlet 32. The function of the auxiliary stream 62 is to stir up the particles at the bottom of the second fluidized bed 12 to be entrained up second fluidized bed by the combination of the primary and auxiliary liquid streams 60 and 62. The two streams 60 and 62 may also be combined into a single stream and the fed through a single distributor at the second fluidized bed 12 bottom end 26.-

Please replace the paragraph beginning on page 5 line 31 with the following

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- The feed liquor 20 as above described enters at the bottom of the bed 10, travels in countercurrent to the particles 18 through the bed 12 and leaves at the top of the bed as indicated at 44. The fluid exiting from 44 is discarded as waste or as a purified stream in the

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case of contaminant removal -

Please replace the paragraph beginning on page 6 line 3 with the following

B9 -The second fluidizing fluid (extract buffer) 28 and the particles 18 from line 42 travel in co-current fashion upward through the bed 12 and are regenerated and then enter the transfer system 16 which includes a separator such as the fluid vortex type separator 46 having a fluid outlet 48 through which the second fluidizing fluid 28 is removed and a solids outlet through a washing stage 50 at the bottom. This fluid exiting from outlet 48 contains the ions of interest and may be subjected to further downstream processing or membrane treatment to concentrate the ions of interest. Washing fluid is injected via nozzle 52 at the bottom of the washing stage 50 and flow upward in countercurrent with the downcoming solids (regenerated solid particles) 18 and the so washed particles 18 enter the inlet tube delivering the regenerated particles 18 into the top of the bed 10. The washing fluid dilutes the extract buffer and exits from the outlet 48.-

Please replace the paragraph beginning on page 6 line 16 with the following

B10 -In the process of ion exchange, the feed liquor 20 is introduced via inlet 22 into the bottom (second) end of the first fluidized bed 10 (downcomer 10) and the regenerated particles 18 from the bed 12 are introduced via line 17 adjacent to the first or the top of the first fluidized bed 10, i.e. the feed 20 and regenerated beads are introduced at opposite ends of the first fluidized bed 10.-

After the paragraph ending on page 7 line 24 please insert the following paragraph

B11 -Although the invention has been illustrated with the feed liquor flowing upwards in countercurrent with the particles in the first fluidized bed and the extract buffer flowing upwards in cocurrent with the particles in the second fluidized bed, it will be clear to those skilled in the art that the two fluidizing fluids can be switched with the feed liquor flowing upwards in cocurrent with the particles in the second fluidized bed and the extract buffer flowing upwards in countercurrent with the particles in the first fluidized bed.-

Please replace the paragraph beginning on page 8 line 12 with the following

B12 -In the liquid solids circulating fluidized bed (LSCFB), diagrammed in Figure 1, the adsorption

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cont.

in the first fluidized bed or downcomer 10 and the desorption in the second fluidized bed or second fluidized bed 12 can be carried out in a continuous mode with the ion exchange particles circulated continuously between the two columns. The ion exchange particles 18 employed in this system should have reasonably large adsorption capacity to the target or desired ions and the density of the ion exchange particles 18 in the swollen state should be larger than that of the feed liquor. As the first fluidized bed 10 is maintained in the conventional fluidization regime, the bed voidage could be adjusted to allow the passage of the particulates in an unclarified feed by controlling the superficial liquid velocity in the first fluidized bed. In other words, this system can be used to purify the target ions directly from an unclarified whole broth so that the costly pre-clarification process is eliminated.-

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After the paragraph ending on page 8 line 30 please insert the following paragraph

-Although the above description uses the first fluidized bed for adsorption and the second fluidized bed for desorption, it will be understood by those skilled in the art that one can also use the second fluidized bed for adsorption and the first fluidized bed for desorption.-

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Please replace the paragraph beginning on page 8 line 32 with the following

In an arrangement as shown in Figure 1, the second fluidized bed 12 is an acrylic column of I.D. 38.1 mm and 3 m in height. The distributor of the second fluidized bed 12 divides the incoming stream of extracting buffer into two substreams: the primary 60 and the auxiliary 62 streams. The primary stream 60 is introduced through a stainless steel pipe (I.D. 11 mm) (nozzle 30). It projects 36 mm into the second fluidized bed column 12. Since the liquid velocity in the second fluidized bed is maintained in a range higher than the terminal velocity of the ion exchange particles, the high liquid velocity enhances the contact efficiency and also the mass transfer rate between the liquid and the particles.

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Please replace the paragraph beginning on page 10 line 5 with the following

-Potential applications of the invention that the invention is believed to be suitable for include but are not limited to:-

In the claims

Please amend claim 1 as follows